

derived by the world from the invention of the steam-engine and the electric telegraph, and from the various applications of chemistry to the industrial arts, have all, until the last few years, radiated from England. We have here the secret of a large part of England's riches and England's strength. But it is useless to hope that the mere knowledge of the acquired facts of science will furnish that new weapon which nations are now adding to the sword to enforce their superiority. The mental soil which produces new ideas for a nation's use can only be cultivated by the discipline of scientific investigation. Further, it cannot be doubted that, as modern civilisation is still further developed, the new ideas which a nation produces and throws into a concrete form will be among the most valuable of its exports, because each nation will work up the old ideas for itself.

AGRICULTURAL EDUCATION

THE application of the law of selection to the production of farm crops and animals offers a certain and wide field for increasing our agricultural wealth. In every department of the farmer's occupation there is great room for improvement if this scientific principle be borne in mind.

It is well known that science has, in our time, thrown extraordinary light on the action of manures. Yet too few of our farmers are guided in their practice by this light. In every district of the United Kingdom farmers apply manures which are either incapable of drawing out the full productive powers of the soil, or comparatively worthless.

Again, it is notorious that the yield of millions of acres of our wet, cold lands could be largely increased by drainage.

There is no branch of agriculture which has progressed so much in modern times as the manufacture of farm implements and machines. Yet, an enlightened and experienced agriculturist who travels through England cannot fail to see an enormous waste of power, arising from the use of unsuitable implements, as well as from ignorance of the elementary principles of mechanical science.

Numerous additional examples could be cited, but it is not necessary. It is enough to state the broad fact that while the foremost of our farmers are the most enlightened in the world, there is a vast number of occupiers of land in Great Britain and Ireland who do not avail themselves of the aids which science is capable of affording them.

To the farmer, as to everybody else, knowledge is power. The increased annual wealth capable of being produced by the application of this power is very considerable. It has been stated by several persons whose opinions on agricultural questions appear to command respect, that the produce of the soil of England could be doubled by improved modes of farming. After having seen from time to time a good deal of English farming, I consider this estimate quite too high; but all thoughtful and experienced persons will concur in the opinion that by the adoption of means which could be called forth, the produce of the soil of Great Britain

would soon be increased to an amount equal to the rental of the entire land of the country; that is to say, *farmers could increase the productive power of the soil to the extent of, say, forty millions sterling a year!* They would reap the first fruits of this harvest. In due time the landlords would come in for their share of it in the shape of increased rents; for, as I have often pointed out, it is a law of agricultural progress that every increase in the productiveness of the land, and every rise in the prices of its products, by increasing the competition for land, tend to raise rents.

How can we increase the productiveness of the land? There are many ways in which progress may be effected; but we must seek the solution of the question mainly in education, using the word in its widest sense.

The wealth of farmers depends on their knowledge, skill, and thrift. Of thrift we shall say nothing in this note. Skill is required by both farmers and labourers. It is a plant of slow growth. The navy acquires it by plodding application. The skill of the high-class agricultural labourer is acquired in the same way. The skill of the high class-farmer, too, is the result of continuous application to business. The skill acquired by one generation is capable of being imparted to, and of being improved upon, by the next. The skill possessed by both agricultural labourers and farmers in England has been thus transmitted from generation to generation, and improved in its transmission, in accordance with a law of development. It would be unfortunate if any circumstances or set of circumstances should interfere with this development. We cannot now discuss this subject; but it may be remarked that one of the features of the present movement in the agricultural labour market which deserves serious attention is, that skilled hands have left many districts. Several very thoughtful English farmers of my acquaintance already complain of want of skill in the young hands who remain at home. In a recent agricultural tour in England I saw evidence of the same state of things. Unless the movement be arrested, English farming will, in all human probability, undergo a change which may be prejudicial to the agricultural interest. What the tendency of that change would be is foreign to the object of this paper, and accordingly I proceed to make a few remarks on the importance of imparting agricultural knowledge.

It has been already affirmed that general knowledge imparts power to every man. This is true in every state of life. It is true in science; it is equally true in the industrial arts. The proposition is supported by an overwhelming mass of evidence. Royal Commissioners, Special Commissioners, and distinguished independent inquirers are all in unison on the question. All our systems of technical education are based on this one leading idea. The whole programme of the Department of Science and Art is based upon it. In the leading cities and towns the rising generation of the manufacturing classes can acquire scientific knowledge which will be of direct use to them in their several pursuits. In the village school scientific truths are imparted which cannot fail to be of use to the trader and artisan.

How different is the case with the farmer! In his education no systematic effort has been made to instil into his mind those elementary scientific truths on which

enlightened agricultural practices are based. The result is, that he grows up in complete ignorance of the rudiments of agricultural science.

How is this state of things to be remedied? In other words, how is a suitable amount of agricultural science to be imparted to farmers?

In answering this question it is important to distinguish between ordinary working farmers who receive their education in Primary schools, and farmers who are able to pay for a higher education, such as is afforded in boarding schools and seminaries and other institutions of the same grade.

As regards the first of these two classes, I would say that I see no reason why an adequate amount of agricultural instruction could not be imparted in the primary schools. All that is required is a suitable text-book or two, and such a system of inspection as will ensure that the book shall be read, and all difficult passages explained by the teachers. This simple system of agricultural education has been tried in Ireland for many years. It has laboured under many difficulties; but as it has succeeded admirably wherever it has been fairly tried, I can have no hesitation in recommending it for adoption elsewhere. To those who desire to introduce it into England I would say, before you start, see that you are upon the right rails, and that you use the proper instruments. In a movement of this kind all sorts of people will come in with all sorts of advice; the busiest and most active of these may be ignorant of the A B C of science and of enlightened agricultural practice. Keep clear of these people. If not, you will either fail altogether, or effect little good, like many others who, from time to time, have embarked in agricultural education.

I look to the diffusion of sound notions of the elements of agricultural science in the way pointed out, as the best means of removing prejudice, and of increasing the agricultural produce of the land in the hands of small farmers.

It is by no means so easy to devise, for the wealthier farmers, a system of agricultural education which will be successful. The words "agricultural education" have led to much confusion of thought; and confusion of thought on any subject works mischief. Some persons use these words in a way which would imply that the farmer should have a special system of education peculiar to himself, from the moment he enters school till he leaves it for good. Of course this is not the case, and it is certain that in the case of large farmers we must look more to the effects of a good general education than of special instruction. The first truths of physical science, of chemistry, and natural history should enter into the curriculum of every middle-class school and college in the country. This knowledge will be useful to the student, no matter what his future calling may be. As regards the farmer, it may be remarked that, without a knowledge of mechanics he cannot be in a position to buy implements and machines to the best advantage, or to understand how to apply horse-power and other forces in the most judicious manner. Look, for example, at the loss of power daily caused by ignorance of the elementary principles involved in common draught. Look at the loss entailed on farmers in the simple matter of common gates for want of knowledge of the means of resisting strains, and of other principles equally elementary. It has been shown

that in the production of animals and plants very great mistakes are committed for want of knowledge of physiology. This science should, therefore, be taught in all our middle-class colleges and schools attended by farmers. We must not, of course, neglect mathematics, the study of which is the very best training for the mind. If the large farmer be well instructed in all the sciences named, agriculture will keep pace with other pursuits in which scientific knowledge is required. It is in the universal inculcation of this scientific knowledge that I look mainly for progress in the management of large farms. I do not wish to undervalue, and I cannot in these papers overlook, special agencies for imparting agricultural knowledge to this class. I refer to agricultural colleges and agricultural schools. Viewing the subject theoretically, one of these institutions would seem to be the most perfect place at which the future farmer could spend a year after leaving school or college, and before he enters into practical work. He could attend lectures, and he ought, one would suppose, to be able to see theory reduced to practice.

But after having carefully inquired into the working of these institutions at home and in parts of the Continent, I am bound to say that their theoretical value has not been realised in practice. In point of fact, taking them as a whole, their history has been peculiarly unfortunate. I shall refer to this subject more fully hereafter. At present it is enough to state that with few exceptions agricultural schools and colleges have failed; and success in the exceptional cases has turned upon the peculiar fitness of the individuals on whom the management has devolved, and who by force of character have produced striking results. A general failure in working out a comprehensive system cannot be accounted for by the shortcomings of individuals. The failure of an institution here and there, for a time, can often be traced to the inefficiency of the person or persons at the head of them; I have before my mind numerous examples of the kind; but in accordance with a well-known law, suitable men would arise if the demand existed. And why has this law not prevailed in the case of agricultural schools and colleges? The apparent answer is, that farmers everywhere have not sent their sons to these institutions in sufficient numbers. And why? In answering this question it has been invariably stated that farmers as a class are slow to do what is for their good; to me this off-hand sort of reply has always appeared most unsatisfactory. Farmers, like every other class, find out, after a time, what is for their good. Intelligent farmers, like intelligent men in every walk of life, study their own interests. Owing to their isolation, or want of daily intercourse, they do not move in the path of progress as rapidly as the manufacturing classes who live in cities and towns, and who are brought into daily intercourse with one another. But when we find farmers standing aloof from any system established with the intention of serving them, we may take it for granted that there is something inherent in the system which requires to be adjusted or is inimical to success. What is this something in the history of agricultural colleges and schools? For obvious reasons I cannot fully state my experience on this question; but I can say that the answer will be partly found in the peculiar state

of farming as a business. Our scientific knowledge of agriculture, even at the present day, is in a very unsettled state. Theories have risen and fallen in a way which has led rent-paying farmers to regard science with indifference and suspicion. We find evidence of this feeling in our daily intercourse with them. To a large extent they are justified by the vagaries of some of the so-called scientists. I see only one feasible remedy for this, and that is the introduction of the necessary quantity of pure science into the education of the farming classes. This cannot be done in an agricultural college or two. It must be done on a national basis; that is, by establishing science classes in every middle-class college and school throughout the length and breadth of the land. And having done this, a few normal schools of agriculture would soon arise to complete and crown the work. If scientific instruction were placed on a national basis, the normal schools would become filled with the best minds in the country. In the absence of such a system an isolated school or college cannot prevent itself from doing mischief in one direction which has escaped attention; I mean, that if the best men do not enter it, inferior men acquire what I may call an artificial brand which enables them to obtain high positions in connection with agricultural industry—for example, as estate agents and managers—to the exclusion of men of superior natural powers, and to the detriment of the national interests. In other words, the natural law of Selection is subverted.

THOMAS BALDWIN

THE SHEEP

The History, Structure, Economy, and Diseases of the Sheep. By W. C. Spooner, M.R.V.C. Third Edition. (London: Lockwood and Co., 1874.)

THROUGHOUT the whole historic period the sheep has been a source of wealth to man. Mutton has been a staple article of human food, and wool one of the staple materials out of which fabrics have been made for human use. At no period in the history of the United Kingdom has the sheep been so much the object of the farmer's solicitude and care as at the present day. A new edition, purporting to be carefully revised and considerably enlarged, of a work exclusively devoted to the animal, from the pen of Mr. W. C. Spooner, V.S., is, therefore, manifestly entitled to attention. Mr. Spooner has written much. To Blackie's "Cyclopædia of Agriculture" he contributed several valuable papers on veterinary subjects. He has written several other thoughtful essays. He is best known as the editor of an edition of White's "Veterinary Art." The work now before us is the one by which he can best be judged as an author. The title of the volume is pretentious. It would lead the reader to expect an exhaustive treatise; but the most superficial examination corrects this impression.

The volume extends to 322 pages. It is divided into three parts. The first part contains eighty-two pages, and is devoted to the history of the several breeds of sheep. The second part treats of the structure and economy of the sheep, and contains 108 pages; and Part III., occupying the remainder of the text, is devoted to the diseases

of the animal. With one or two exceptions, the matter is arranged under these three heads. The exceptions are, however, unpleasant and unaccountable. This arises, to some extent, from treating of the structure and "economy" under one general heading. In this part of the work the author treats of breeding and feeding, which, according to his notions, are manifestly embraced in the term "economy." In the historical section of the book a good deal of information is given on the origin of new breeds, and it is to the repetition of some of this in the chapters on breeding, and the influence of ram sales in the second part of the book, that exception may justly be taken. Tautology, in this busy age, is a great fault. In the present instance it is the less pardonable, because it is not necessary, or even intended, to call back the mind to principles previously expounded.

In the account given of the several breeds no principle of classification appears to have been kept in view. The practical value of the facts is not, of course, lessened by this circumstance; but it must be admitted that the value of a book is greatly enhanced to the public by a proper classification and arrangement of its matter. Judged by this standard, Mr. Spooner's work is singularly defective. In an essay or chapter on breeding, in Part II., we are treated to a disquisition on the merits of the several kinds of sheep which should have been embodied in the description of the several breeds in Part I. In the section devoted to feeding, there are certain theoretical considerations on the size and structure of the chest and abdomen, which should have appeared in the account of the structure of those regions given in an earlier part of the same section.

It is a most ungracious task to write unfavourably of a work of this kind, but the truth is that this new edition affords evidence of great want of care and thought in its preparation. Words and phrases, and even whole sentences, occur throughout the work which illustrate this statement. Take, for example, the following sentence, which occurs in the section on feeding:—"The superiority of particular improved breeds is now generally acknowledged, and may indeed be considered to be established on certain principles, though in arriving at these principles it must be confessed that we are little indebted to science, but rather to the long and attentive observation and correct reasoning of practical men." Overlooking the defective structure of the whole of this sentence, we would observe that the author's view of the nature of science must be peculiar, to say the least of it. If attentive observation and correct reasoning be not science, we should like to know how science ever arose. It would seem as if speculative reasoning were synonymous with science in the mind of our author.

We take another illustration of the culpable want of care bestowed on the preparation of this work from the section devoted to the treatment of scab. Dipping in arsenic is first of all recommended as one of "the most simple and most effectual." Nothing has been said of the dangers attending the use of this substance, or of the consequences which have often followed its use. Mercurial ointment is also recommended. We are told that "tobacco-water is another remedy which has been found effectual, but the high duty it is subject to limits its application." The author ought to have known that tobacco used for this